

5   **CLAIMS**

We claim:

1.   An apparatus comprising:
  - a local area network, operably coupled to at least one positron emission tomography imaging system;
  - 10   a dispensing station to receive a multidose vial of a radiotracer, and to dispense portions of the radiotracer, at least one positron emission tomography imaging system, the dispensing station being operably coupled to the local area network; and
  - 15   a control system operably coupled to the local area network, to receive status information from, and send commands to, the at least one positron emission tomography imaging system and the dispensing station.
2.   The apparatus of claim 1, further comprising a quality control unit, to monitor the radionuclic and chemical purity of the radiotracer that is dispensed by the dispensing station, the quality control unit being operably coupled to the local area network, operably coupled to the control system and operably coupled to the dispensing station.
3.   The apparatus of claim 1, wherein the local area network is further operably coupled to a radioisotope producer and wherein the dispensing station receives the radioisotope from the radioisotope producer.
4.   The apparatus of claim 3, wherein the radioisotope producer further comprises a cyclotron.
- 30   5.   The apparatus of claim 3, wherein the radioisotope producer further comprises a linear accelerator.
6.   The apparatus of claim 3, wherein the radioisotope producer further comprises a radioisotope generator.
- 35   7.   The apparatus of claim 1, wherein the apparatus further comprises being mounted on wheels.

- 5     8.     The apparatus of claim 1, wherein a radioactivity shield surrounds portions of the apparatus that are radioactive.
9.     The apparatus of claim 1, wherein the radiotracer further comprises nitrogen-13 ammonia.
- 10     10.    The apparatus of claim 1, wherein the radiotracer further comprises fluorodeoxyglucose.
11.    The apparatus of claim 1, wherein the at least one positron emission tomography imaging system further comprises a plurality of positron emission tomography imaging systems.
- 15     12.    The apparatus of claim 1, wherein each positron emission tomography imaging system further comprises:
- a computer system having a graphical user interface operably coupled to the local area network;
  - an injector system to extract at least one individual dose from the radiotracer and to inject the at least one individual dose into the living subject, the injector system being operably coupled to the local area network; and
  - a physiologic monitoring system operably coupled to the injector system and operably coupled to the living subject.
- 20     13.    The apparatus of claim 12, wherein the amount of each individual dose is calculated based on the radioactive half-life of the radiotracer, the projected time of injection into a living subject and high level descriptors of the living subject.
- 25     14.    The apparatus of claim 13, wherein the high level descriptors of the living subject further comprise the weight, sex and physical dimensions of the living subject.
- 30     15.    The apparatus of claim 1, wherein the control system further comprises a computer system.
- 35     16.    A medical radiopharmaceutical administration system comprising:  
          a local area network, operably coupled to at least one positron emission tomography imaging system and operably coupled to a radioisotope producer;

- 5        a chemical synthesizer operably coupled to the radioisotope producer, to receive the  
radioisotope, and to produce a radiotracer;
- 10      a dispensing station to receive from the chemical synthesizer a liquid radiotracer in  
quantities suitable for multiple doses of the radiopharmaceutical, and to dispense  
the radiopharmaceutical to the at least one positron emission tomography imaging  
system, the dispensing station being operably coupled to the local area network;  
and
- 15      a control system operably coupled to the local area network, to receive status information  
from, and send commands to, the at least one positron emission tomography  
imaging system and the dispensing station.
17.     The medical radiopharmaceutical administration system of claim 16, further comprising a  
quality control unit, to monitor the radionuclic and chemical purity of the  
radiopharmaceutical that is dispensed by the dispensing station, the quality control unit  
being operably coupled to the local area network, operably coupled to the control system  
20      and operably coupled to the dispensing station.
18.     The medical radiopharmaceutical administration system of claim 16, wherein the  
radioisotope producer further comprises a cyclotron.
- 25     19.    The medical radiopharmaceutical administration system of claim 16, wherein the  
radioisotope producer further comprises a linear accelerator.
20.     The medical radiopharmaceutical administration system of claim 16, wherein the  
radioisotope producer further comprises a radioisotope generator.
- 30     21.    The medical radiopharmaceutical administration system of claim 16, wherein the system  
further comprises being mounted on wheels.
- 35     22.    The medical radiopharmaceutical administration system of claim 16, wherein the  
radiotracer is selected from the group consisting of nitrogen-13 ammonia and  
fluorodeoxyglucose.

- 5    23.    The medical radiopharmaceutical administration system of claim 16, wherein the at least  
one positron emission tomography imaging system further comprises a plurality of positron  
emission tomography imaging systems.
- 10    24.    The medical radiopharmaceutical administration system of claim 16, wherein each of the  
at least one positron emission tomography imaging system further comprises:  
a computer system having a graphical user interface operably coupled to the local area  
network;  
an injector system to extract at least one individual dose from the liquid  
radiopharmaceutical and to inject the at least one individual dose into the living  
15    subject, the injector system being operably coupled to the local area network; and  
a physiologic monitoring system operably coupled to the injector system and operably  
coupled to the living subject.
- 20    25.    The medical radiopharmaceutical administration system of claim 24, wherein the amount  
of each individual dose is calculated based on type of radiopharmaceutical, a predefined  
parametric equation, clinical protocol being followed and high level descriptors of the living  
subject, wherein the high level descriptors of the living subject further comprise the weight, sex  
and physical dimensions of the living subject.
- 25    26.    A portable medical radiopharmaceutical administration system comprising:  
a local area network, operably coupled to at least one positron emission tomography  
imaging system;  
a dispensing station to receive a liquid radiopharmaceutical in quantities suitable for  
multiple doses of the radiopharmaceutical, and to dispense the  
30    radiopharmaceutical to the at least one positron emission tomography imaging  
system, the dispensing station being operably coupled to the local area network;  
a control system operably coupled to the local area network, to receive status information  
from, and send commands to, the at least one positron emission tomography  
imaging system, the dispensing station, and the quality control unit;  
35    a radioactivity shield that surrounds portions of the medical radiopharmaceutical  
administration system that are radioactive; and  
wheels mounted to the shield.

- 5    27. The portable medical radiopharmaceutical administration system of claim 26, wherein the portions of the system that are radioactive further comprise the dispensing station and the quality control unit.
- 10    28. The portable medical radiopharmaceutical administration system of claim 26, wherein the local area network is further operably coupled to a radioisotope producer and wherein the dispensing station receives the liquid radiopharmaceutical from the radioisotope producer.
- 15    29. The portable medical radiopharmaceutical administration system of claim 28, wherein the radioisotope producer further comprises a cyclotron.
30.    The portable medical radiopharmaceutical administration system of claim 28, wherein the radioisotope producer further comprises a linear accelerator.
- 20    31.    The portable medical radiopharmaceutical administration system of claim 28, wherein the radioisotope producer further comprises a radioisotope generator.
32.    The portable medical radiopharmaceutical administration system of claim 26, wherein the radiopharmaceutical is selected from the group consisting of nitrogen-13, fluorine-18, carbon-11, oxygen-15 and rubidium-82.
- 25    33.    The portable medical radiopharmaceutical administration system of claim 26, wherein the at least one positron emission tomography imaging system further comprises a plurality of positron emission tomography imaging systems and wherein each of the at least one positron emission tomography imaging system further comprises:
- 30    a computer system having a graphical user interface operably coupled to the local area network;
- 35    an injector system to extract at least one individual dose from the liquid radiopharmaceutical and to inject the at least one individual dose into the living subject, the injector system being operably coupled to the local area network; and
34.    The portable medical radiopharmaceutical administration system of claim 33, wherein the amount of each individual dose is calculated based on type of radiopharmaceutical, a predefined

- 5 parametric equation, clinical protocol being followed and high level descriptors of the living subject, wherein the high level descriptors of the living subject further comprise the weight, sex and physical dimensions of the living subject.
35. A medical radiopharmaceutical administration system comprising:  
10 a local area network, operably coupled to at least one positron emission tomography imaging system;  
a dispensing station to receive a nitrogen-13 ammonia in quantities suitable for multiple doses of the nitrogen-13 ammonia, and to dispense the nitrogen-13 ammonia to the at least one positron emission tomography imaging system, the dispensing station being operably coupled to the local area network;  
15 a quality control unit, to monitor the amount of radiochemical and the radionuclic purity of the nitrogen-13 ammonia that is dispensed by the dispensing station, the quality control unit being operably coupled to the local area network and operably coupled to the dispensing station; and  
20 a control system operably coupled to the local area network, to receive status information from, and send commands to, the at least one positron emission tomography imaging system, the dispensing station, and the quality control unit.
36. The medical radiopharmaceutical administration system of claim 35, wherein the local area network is further operably coupled to a radioisotope producer selecting from the group consisting of a cyclotron, and a linear accelerator, and wherein the dispensing station receives the nitrogen-13 ammonia from the radioisotope producer.  
25
37. The medical radiopharmaceutical administration system of claim 35, wherein the system further comprises being mounted on wheels.  
30
38. The medical radiopharmaceutical administration system of claim 35, wherein the at least one positron emission tomography imaging system further comprises a plurality of positron emission tomography imaging systems, and wherein each of the at least one positron emission tomography imaging system further comprises:  
35 a computer system having a graphical user interface operably coupled to the local area network;

5       an injector system to extract at least one individual dose from the nitrogen-13 ammonia  
          and to inject the at least one individual dose into the living subject, the injector  
          system being operably coupled to the local area network; and  
a physiologic monitoring system operably coupled to the injector system and operably  
coupled to the living subject.

10

39.     The medical radiopharmaceutical administration system of claim 38, wherein the amount  
of each individual dose is calculated based on a predefined parametric equation, clinical  
protocol being followed and high level descriptors of the living subject, wherein the high level  
descriptors of the living subject further comprise the weight, sex and physical dimensions of the  
15     living subject.

20

40.     A medical radiopharmaceutical administration system comprising:  
a local area network, operably coupled to at least one positron emission tomography  
imaging system;

a dispensing station to receive liquid fluorodeoxyglucose in quantities suitable for  
multiple doses of the liquid fluorodeoxyglucose, and to dispense the  
fluorodeoxyglucose to the at least one positron emission tomography imaging  
system, the dispensing station being operably coupled to the local area network;  
and

25     a control system operably coupled to the local area network, to receive status information  
from, and send commands to, the at least one positron emission tomography  
imaging system, the dispensing station, and the quality control unit.

41.     The medical radiopharmaceutical administration system of claim 40, wherein the local  
30     area network is further operably coupled to a cyclotron and wherein the dispensing station  
receives the liquid fluorodeoxyglucose.

42.     The medical radiopharmaceutical administration system of claim 40, wherein the system  
further comprises being mounted on wheels.

35

43.     The medical radiopharmaceutical administration system of claim 40, wherein the at least  
one positron emission tomography imaging system further comprises a plurality of positron  
emission tomography imaging systems, and wherein each of the at least one positron emission  
tomography imaging system further comprises:

- 5        a computer system having a graphical user interface operably coupled to the local area  
            network;  
an injector system to extract at least one individual dose from the liquid  
            fluorodeoxyglucose and to inject the at least one individual dose into the living  
            subject, the injector system being operably coupled to the local area network; and  
10      a physiologic monitoring system operably coupled to the injector system and operably  
            coupled to the living subject.
44.     The medical radiopharmaceutical administration system of claim 43, wherein the amount  
of each individual dose is calculated based on a predefined parametric equation, clinical  
15      protocol being followed and high level descriptors of the living subject, wherein the high level  
descriptors of the living subject further comprise the weight, sex and physical dimensions of the  
living subject.
45.     A medical radiopharmaceutical administration system comprising:  
20      a local area network, operably coupled to a plurality of positron emission tomography  
            imaging systems;  
a dispensing station to receive a liquid radiotracer in quantities suitable for multiple doses  
            of a radiopharmaceutical, and to dispense the radiopharmaceutical to the plurality  
            of positron emission tomography imaging systems, the dispensing station being  
25      operably coupled to the local area network;  
a quality control unit, to monitor the amount of radio and the radionuclic purity of the  
radiopharmaceutical that is dispensed by the dispensing station, the quality  
            control unit being operably coupled to the local area network and operably  
            coupled to the dispensing station; and  
30      a control system operably coupled to the local area network, to receive status information  
            from, and send commands to, the plurality of positron emission tomography  
            imaging systems, the dispensing station, and the quality control unit.
46.     The medical radiopharmaceutical administration system of claim 45, wherein the local  
35      area network is further operably coupled to a cyclotron and wherein the dispensing station  
receives the liquid radiopharmaceutical from the cyclotron.
47.     The medical radiopharmaceutical administration system of claim 45, wherein the system  
further comprises being mounted on wheels.

48. The medical radiopharmaceutical administration system of claim 45, wherein a radioactivity shield surrounds portions of the system that are radioactive.

49. The medical radiopharmaceutical administration system of claim 45, wherein the  
10 radiotracer further comprises nitrogen-13 ammonia.

50. The medical radiopharmaceutical administration system of claim 45, wherein the radiotracer further comprises fluorodeoxyglucose.

15 51. The medical radiopharmaceutical administration system of claim 45, wherein each of the plurality of positron emission tomography imaging systems further comprises:  
a computer system having a graphical user interface operably coupled to the local area network;  
an injector system to extract at least one individual dose from the liquid  
20 radiopharmaceutical and to inject the at least one individual dose into the living subject, the injector system being operably coupled to the local area network; and  
a physiologic monitoring system operably coupled to the injector system and operably coupled to the living subject.

25 52. The medical radiopharmaceutical administration system of claim 51, wherein the amount of each individual dose is calculated based type of radiopharmaceutical, a predefined parametric equation, clinical protocol being followed and high level descriptors of the living subject.

30 53. The medical radiopharmaceutical administration system of claim 52, wherein the high level descriptors of the living subject further comprise the weight, sex and physical dimensions of the living subject.

54. The medical radiopharmaceutical administration system of claim 45, further comprising a chemical synthesizer operably coupled to the dispensing station, to receive a radioisotope, and to  
35 produce a radiotracer, and to transfer the radiotracer to the dispensing station.

55. A radiopharmaceutical administration system comprising:  
a local area network, operably coupled to a plurality of positron emission tomography imaging systems;

5        a dispensing station to receive a liquid radiopharmaceutical in quantities suitable for  
multiple doses of the radiopharmaceutical, and to dispense the  
radiopharmaceutical to the plurality of positron emission tomography imaging  
systems, the dispensing station being operably coupled to the local area network;  
a quality control unit, to monitor the amount of radiochemical and the radionuclic purity  
10      of the radiopharmaceutical that is dispensed by the dispensing station, the quality  
control unit being operably coupled to the local area network and operably  
coupled to the dispensing station; and  
a control system operably coupled to the local area network, to receive status information  
from, and send commands to, the plurality of positron emission tomography  
15      imaging systems, the dispensing station, and the quality control unit,  
wherein each of the plurality of positron emission tomography imaging systems further  
comprises:  
a computer system having a graphical user interface operably coupled to the local  
area network;  
20      an injector system to extract at least one individual dose from the liquid  
radiopharmaceutical and to inject the at least one individual dose into the  
living subject, the injector system being operably coupled to the local area  
network; and  
a physiologic monitoring system operably coupled to the injector system and  
25      operably coupled to the living subject.

56.      The radiopharmaceutical administration system of claim 55, wherein the local area  
network is further operably coupled to a cyclotron and wherein the dispensing station receives  
the liquid radiopharmaceutical from the cyclotron.

30      57.      The radiopharmaceutical administration system of claim 55, wherein the system further  
comprises being mounted on wheels.

35      58.      The radiopharmaceutical administration system of claim 55, wherein the radiotracer  
further comprises being selected from the group consisting of nitrogen-13 ammonia and  
fluorodeoxyglucose.

- 5        59.      The radiopharmaceutical administration system of claim 55, wherein the amount of each individual dose is calculated based on type of radiopharmaceutical, a predefined parametric equation, clinical protocol being followed and high level descriptors of the living subject.
- 10      60.      The radiopharmaceutical administration system of claim 59, wherein the high level descriptors of the living subject further comprise the weight, sex and physical dimensions of the living subject.
- 15      61.      A medical radiopharmaceutical administration system comprising:  
                a local area network, operably coupled to a plurality of positron emission tomography imaging systems;
- 20      a dispensing station to receive a liquid radiopharmaceutical in quantities suitable for multiple doses of the radiopharmaceutical, and to dispense the radiopharmaceutical to the plurality of positron emission tomography imaging systems, the dispensing station being operably coupled to the local area network;  
a quality control unit, to monitor the amount of radiochemical and the radionuclic purity of the radiopharmaceutical that is dispensed by the dispensing station, the quality control unit being operably coupled to the local area network and operably coupled to the dispensing station; and
- 25      a control system operably coupled to the local area network, to receive status information from, and send commands to, the plurality of positron emission tomography imaging systems, the dispensing station, and the quality control unit,  
wherein each of the plurality of positron emission tomography imaging systems further comprises:  
                a computer system having a graphical user interface operably coupled to the local area network;
- 30      an injector system to extract at least one individual dose from the liquid radiopharmaceutical and to inject the at least one individual dose into the patient, the injector system being operably coupled to the local area network; and
- 35      a physiologic monitoring system operably coupled to the injector system and operably coupled to the patient.

- 5       62.     The medical radiopharmaceutical administration system of claim 61, wherein the local area network is further operably coupled to a cyclotron and wherein the dispensing station receives the liquid radiopharmaceutical from the cyclotron.
- 10      63.     The medical radiopharmaceutical administration system of claim 61, wherein the radiopharmaceutical is selected from a group consisting of nitrogen-13 , fluorine-18, carbon-11, oxygen-15 and rubidium-82.
- 15      64.     The medical radiopharmaceutical administration system of claim 61, wherein the amount of each individual dose is calculated based on type of radiopharmaceutical, a predefined parametric equation, clinical protocol being followed and high level descriptors of the patient, and wherein the high level descriptors of the patient further comprise the weight, sex and physical dimensions of the patient.
- 20      65.     A system comprising:  
                a local area network, operably coupled to means for positron emission tomography imaging;  
                means for dispensing a radiopharmaceutical to the means for positron emission tomography imaging system, the means for receiving and dispensing being operably coupled to the local area network;
- 25      means for monitoring the quality of the radiopharmaceutical that is dispensed by dispensing means, the means for monitoring being operably coupled to the local area network and operably coupled to the dispensing means;  
                means for receiving status information from the means for positron emission tomography imaging, the means for dispensing, and the means for monitoring, the means for receiving being operably coupled to the local area network; and
- 30      means for sending commands to the means for positron emission tomography imaging, the means for dispensing and the means for monitoring, the means for sending being operably coupled to the local area network.
- 35      66.     An apparatus comprising:  
                a computer system having a graphical user interface;  
                an injector system to extract individual doses from a multidose vial of a radiopharmaceutical and to inject the individual doses into a patient, the injector system being operably coupled to the computer system; and

5        a physiologic monitoring system operably coupled to the injector system and operably  
coupled to the patient.

67.      The apparatus of claim 66, wherein the computer system receives data from the  
physiologic monitoring system, the injector system, a keyboard and the graphical user interface,  
10 and sends commands to the injector system.

68.      The apparatus of claim 66, wherein the amount of each individual dose is calculated  
based on the radioactive half-life of the radiopharmaceutical, the projected time of injection into  
a living subject and high level descriptors of the patient.

15        69.      The apparatus of claim 66, wherein the high level descriptors of the living subject further  
comprise the weight, sex and physical dimensions of the patient.

20        70.      A positron emission tomography imaging system comprising:  
an injector;  
a physiologic monitor operably coupled to the injector; and  
a positron emission tomography scanner operably coupled to the physiologic monitor and  
the injector.

25        71.      The positron emission tomography imaging system of claim 70, wherein the injector is  
operable to inject individual doses of a radiopharmaceutical into a patient.

72.      The positron emission tomography imaging system of claim 70, wherein the radiotracer  
further comprises nitrogen-13 ammonia.

30        73.      The positron emission tomography imaging system of claim 70, wherein the radiotracer  
further comprises fluorodeoxyglucose.

74.      The positron emission tomography imaging system of claim 70, wherein the physiologic  
35 monitor is operably to monitor blood pressure and heart activity.

75.      The positron emission tomography imaging system of claim 70, wherein the operable  
coupling is provided by a local area network.

- 5    76. The positron emission tomography imaging system of claim 70, further comprising a computer system operably coupled to the local area network, to control dispensing and injection of an individual dose of a radiopharmaceutical into a living subject and to control radiological scanning of the living subject.
- 10    77. A computer-accessible medium having executable instructions to manage radiotracer production, the executable instructions capable of directing a processor to perform:  
receiving radiotracer material request information;  
determining amount of radioactivity needed from the request information;  
sending production instructions including the amount of radioactivity and the amount of  
15    radiotracer to a cyclotron and a synthesis unit; and  
sending instructions to the dispensing station.
- 20    78. The computer-accessible medium of claim 77, wherein the radiotracer request information further comprises the weight, sex and physical dimensions of at least one living subject.
- 25    79. The computer-accessible medium of claim 77, wherein the radiotracer further comprises nitrogen-13 ammonia.
- 30    80. The computer-accessible medium of claim 77, wherein the radiotracer further comprises fluorodeoxyglucose.
- 35    81. A computer-accessible medium having executable instructions to manage radiotracer production, the executable instructions capable of directing a processor to perform:  
calculating a required radiotracer dose activity;  
comparing a total activity available in the multidose portion of the radiotracer to the required radiotracer dose activity; and  
notifying of the additional dose activity required and what time the additional, if the comparing indicates that there will be a shortage.
- 35    82. The computer-accessible medium of claim 81, wherein the notifying further comprises:  
notifying an operator of the computer-accessible medium of the additional dose activity required and what time the additional, if the comparing indicates that there will be a shortage.

5

83. The computer-accessible medium of claim 81, wherein the notifying further comprises:  
notifying an outside radioisotope supplier of the additional dose activity required and  
what time the additional, if the comparing indicates that there will be a shortage.

10 84. A computer-accessible medium having executable instructions to manage radiotracer  
injection, the executable instructions capable of directing a processor to perform:  
injecting the radiotracer into a patient;  
initiating scanning of the patient after a first predefined time; and  
introducing a pharmaceutical stress agent into the patient.

15

85. The computer-accessible medium of claim 84, wherein the computer-accessible medium  
further comprises instructions capable of directing a processor to perform:  
injecting the radiotracer into patient; and  
imaging the patient after a second predefined time.